4.4 Food and Farm Product Surveillance

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Foodstuffs, including milk, vegetables, fruits, and wine, were collected in 1998 at several locations surrounding the Hanford Site (Figure 4.4.1). Samples were collected primarily from locations in the prevailing downwind directions (south and east of the site) where deposition of airborne effluents or fugitive dust from the Hanford Site could be expected. Samples were also collected in generally upwind directions and at locations somewhat distant from the site to provide information on background radioactivity.

The food and farm product sampling design addresses the potential influence of Hanford Site releases in two ways: 1) by comparing results from several downwind locations to those from generally upwind or distant locations and 2) by comparing results from locations irrigated with Columbia River water withdrawn downstream from the Hanford Site to results from locations irrigated with water from other sources. In 1996, the food and farm product sampling schedule was modified by establishing a 2- or 3-year rotation for certain farm products. Additionally, analyses for specific radionuclides that historically have not been detected in a food or farm product were discontinued. These changes were adopted because of the emphasis on cleanup of the site. Specific details of the 1998 food and farm product sampling design, including sampling locations and radionuclides analyzed, are reported in DOE/RL-91-50, Rev. 2 and PNNL-11803 and are summarized in Table 4.4.1.

Gamma scans (cobalt-60, cesium-137, and other radionuclides; see Appendix E) and strontium-90 analyses were performed routinely for nearly all products. Additionally, milk was analyzed for iodine-129 and tritium, and wine was analyzed for tritium. Results for fruits and vegetables are reported in picocuries per gram wet weight. Results for tritium are reported in picocuries per liter of liquid distilled from milk and wine. Most tritium is found as water, and very little tritium is organically bound to other constituents present in food products.

Tritium and iodine-129 from site facilities are released to the atmosphere and to the Columbia River via riverbank springs. Strontium-90 from Hanford is released to the Columbia River through riverbank springs. Cesium-137 is present in atmospheric fallout from weapons testing and is found in site radiological waste.

For many radionuclides, activities are below levels that can be detected by the analytical laboratory. When this occurs for an entire group of samples, a nominal detection limit is determined by using two times the total propagated analytical uncertainty (2 sigma). This value from a group of samples is used as an estimate of the lower level of detection for that analyte and particular food product. The total propagated analytical uncertainty includes all sources of analytical error associated with the analysis (e.g., counting errors and errors associated with weight and volumetric measurements). Theoretically, reanalysis of the sample should yield a result that falls within the range of the uncertainty 95% of the time. Results and uncertainties not given in this report may be found in PNNL-12088, APP. 1.

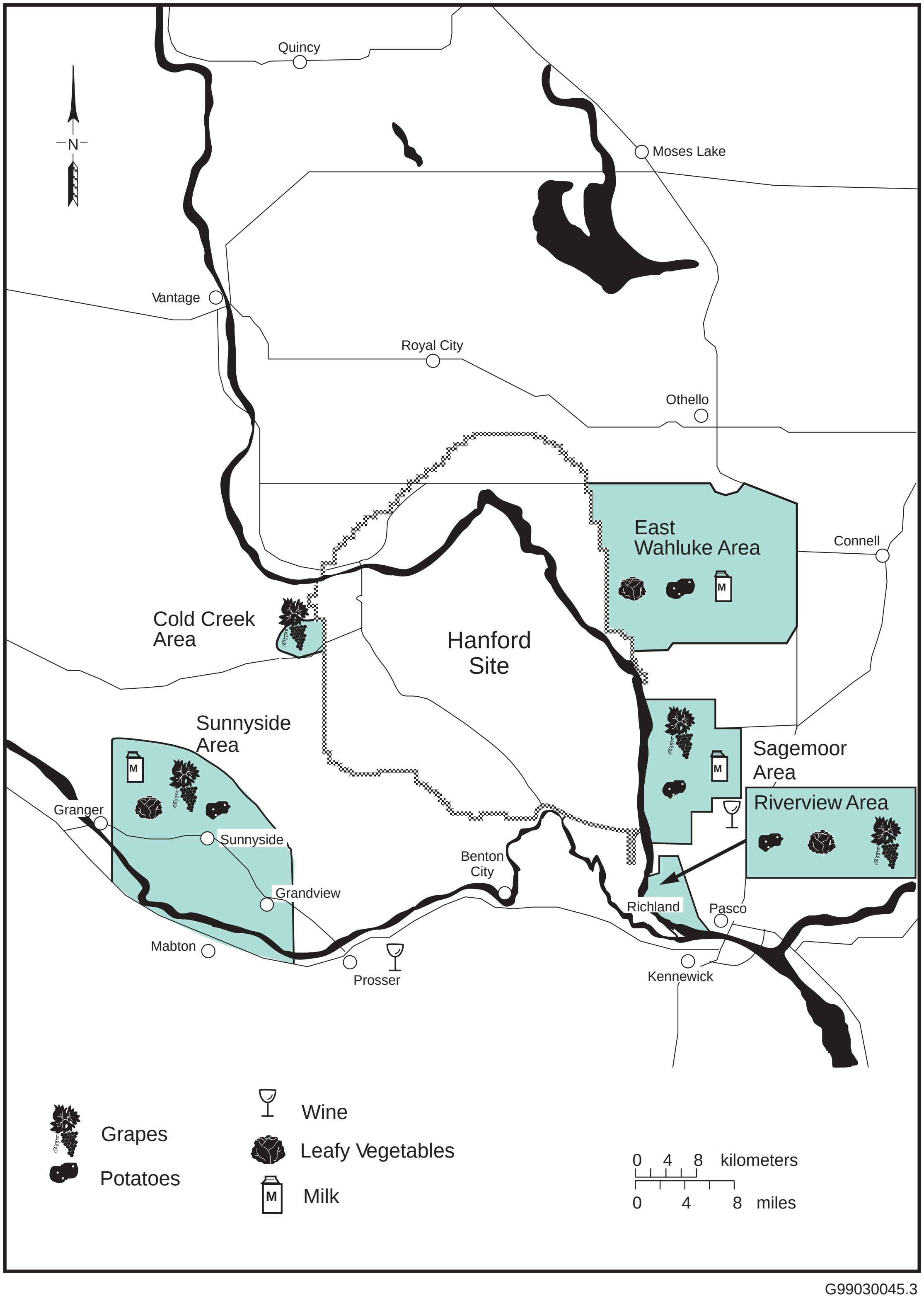

Figure 4.4.1. Food and Farm Product Sampling Locations, 1998

Table 4.4.1. Locations, Sampling Frequencies, and Analyses Performed for Routinely Sampled Food and Farm Products, 1998[a]

	Number of Locations			Number of Locations Analyzed			
Product	**Upwind**	**Downwind**	**Sampling Frequency[b]**	**^{3}H**	**Gamma**	**^{90}Sr**	**^{129}I**
Milk	1	2	Q or SA	3	3	3	3
Vegetables	1	2	A	0	4	4	0
Fruit	2	2	A	0	4	4	0
Wine	2	2	A	4[c]	4	0	0

(a) Products may include multiple varieties for each category.
(b) Q = quarterly, SA = semiannually, A = annually.
(c) Samples lost during analyses; results provided by Washington State Department of Health on cosamples.

4.4.1 Milk Samples and Analytes of Interest

Composite samples of raw, whole milk were collected in 1998 from three East Wahluke Area and two Sagemoor Area dairy farms. These sampling areas are located near the site perimeter in the prevailingly downwind direction (see Figure 4.4.1). Milk samples were also collected from a Sunnyside Area dairy to indicate background radionuclide activities at a generally upwind location.

Milk was analyzed for tritium, strontium-90, iodine-129, and gamma emitters such as cesium-137 because these radionuclides have the potential to move through the air-pasture-cow milk or water-pasture-cow milk food chains to humans. Gamma scans and strontium-90 analyses were conducted quarterly, and iodine-129 analyses were conducted on two semiannual composite samples. Tritium analyses were discontinued in 1995 because tritium activities had dropped below the detection level of standard liquid scintillation counting methods. In 1998, an electrolytic enrichment technique (DOE/RL-91-50, Rev. 2) for measuring tritium in milk samples was instituted. The electrolytic enrichment technique has a detection limit of approximately 10 pCi/L of water distilled from milk.

One factor influencing activities of radionuclides in milk is the source of food for the dairy cows. Dairy cows may be fed food grown outside of the sampling area in which the dairy farm is located. Generally, levels of fallout radioactivity in environmental media correlate positively with the amount of precipitation that an area receives. The agricultural areas around the site are arid and historically have received less rain, and, therefore, less weapons-testing atmospheric fallout than some distant locations. Consequently, levels of radioactivity in hay or alfalfa grown in some distant, rainy locations and purchased by local dairies may contribute more radioactivity to milk than contaminant levels in feed grown locally. Alternatively, it is possible that alfalfa fed to dairy cows in the Sunnyside Area could have been grown in areas downwind of Hanford (e.g., Sagemoor Area). Fallout radionuclides in feed may be a significant source of radioactivity in milk products; however, measured levels of radionuclides in milk are usually near levels considered to be background.

Strontium-90 was measured in 6 of 12 (50%) milk samples analyzed in 1998, with no apparent differences between upwind and downwind locations.

Strontium-90 activities remain near the nominal detection limit (0.7 pCi/L) and have been relatively constant over the past 6 yr (Figure 4.4.2). The maximum observed strontium-90 activity in milk in 1998 was 0.95 ± 0.38 pCi/L in a Sunnyside Area sample. Strontium-90 in milk collected from the Sagemoor Area was essentially below detection (<0.5 pCi/L) in all samples. While there is no strontium-90 standard for milk, the drinking water standard (based on a 2-L/d consumption) is 8 pCi/L (40 CFR 141). The maximum milk consumption rate for estimating dose is approximately 0.75 L/d (see Appendix D, Table D.2).

Iodine-129 was identified by high-resolution mass spectrometry in six milk samples. In recent years, the levels of iodine-129 in milk collected from generally downwind dairies in the Sagemoor and East Wahluke Areas have persisted at levels two to four times greater than levels measured upwind in Sunnyside (Figure 4.4.3). Iodine-129 activities have been declining with the end of nuclear production activities on the site and contribute <1% of the dose to the maximally exposed individual through the consumption of dairy products (see Section 5.0, "Potential Radiological Doses from 1998 Hanford Operations"). The maximum observed iodine-129 in milk in 1998 was 0.0007 ± 0.0001 pCi/L in a sample collected from the Sagemoor Area. While there is no iodine-129 standard for milk, the drinking water standard is 1 pCi/L (EPA-570/9-76-003).

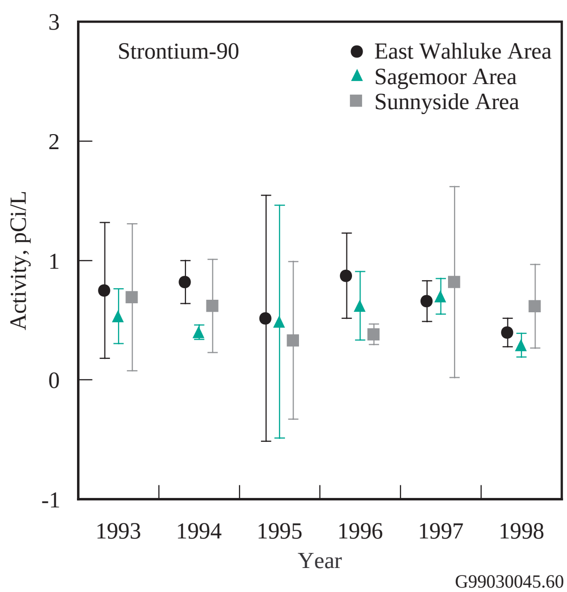

Figure 4.4.2. Median, Maximum, and Minimum Strontium-90 Activities in Milk, 1993 Through 1998

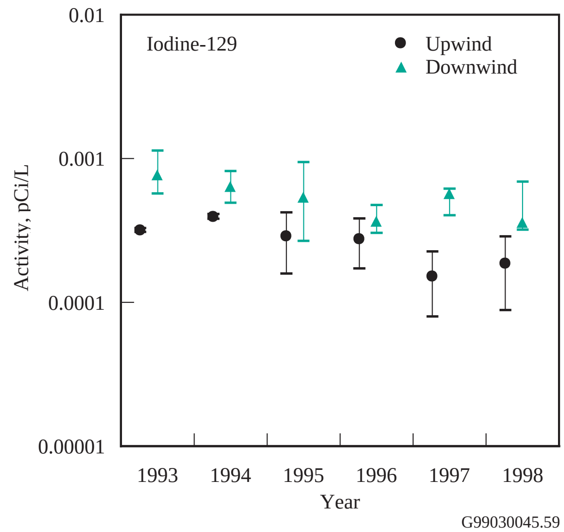

Figure 4.4.3. Median, Maximum, and Minimum Iodine-129 Activities in Milk, 1993 Through 1998

None of the 12 milk samples collected and analyzed in 1998 contained detectable cesium-137 activities (<3.3 pCi/L). Because there is no cesium-137 standard for milk, the drinking water standard is 200 pCi/L (EPA-570/9-76-003). Additionally, no other man-made gamma emitters were detectable in milk (PNNL-12088, APP. 1).

Tritium was analyzed by the electrolytic enrichment method in quarterly composite milk samples from the Wahluke and Sagemoor Areas and the single sample from the Sunnyside Area for the first three quarters of 1998. For the first two quarters, tritium activities in milk were similar at each dairy. The apparent increase in the third quarter for each dairy may be attributed to elevated counts in the laboratory blank (laboratory background sample). The most interesting observation is the consistent relative differences between the three sampling areas. A plausible explanation for these differences may be the drinking water provided to cows at the participating dairies. The dairies in all three areas use well water. The aquifers in Franklin County for the dairies in the Sagemoor and Wahluke Areas have historically been recharged by Columbia River water brought into the areas by the Columbia Basin Irrigation Project. Background tritium activities in Columbia River water in the 1960s ranged from 800 to 5,540 pCi/L that resulted from fallout from nuclear weapons detonated above the ground (Wyerman et al. 1970). Irrigation water from the Columbia River containing these comparatively high tritium activities entered the groundwater aquifers in Franklin County as a result of overapplication and leaking canals. This water remains in the aquifers that provide water for the dairies. Over the past 30 yr, tritium activities have slowly decreased as a result of radiological decay and possible dilution caused by subsequent recharge with less-contaminated irrigation water. Based on a 12.3-yr half-life, if we assume an aquifer having an activity of 1,000 pCi/L in 1963 (assumes some dilution with natural groundwater), the estimated level after three half-lives in 1998 would be 125 pCi/L.

Sampling and analysis of dairy water and milk from each participating dairy were initiated in the fall of 1998, but analytical problems with electrolytic enrichment of milk and wine samples have delayed this study. Data collected in 1999 are expected to demonstrate the direct relationship of tritium in well water and milk at each dairy. Information is being gathered on past irrigation practices in the Columbia Basin and the lower Yakima Valley. While the relationships between tritium in milk and groundwater used by the dairies are interesting, the actual levels of tritium in milk make a minor contribution to the dose of those who consume milk (see Section 5.0, "Potential Radiological Doses from 1998 Hanford Operations").

4.4.2 Vegetable Samples and Analytes of Interest

Samples of leafy vegetables (i.e., cabbage, rhubarb, beet tops) and potatoes were obtained during the summer from gardens and farms located within selected sampling areas (see Figure 4.4.1). Leafy vegetables were sampled to monitor for the potential deposition of airborne contaminants. The Riverview Area was sampled because of its exposure to potentially contaminated irrigation water withdrawn from the Columbia River downstream of the Hanford Site. All vegetable samples were analyzed for gamma-emitting radionuclides and strontium-90.

Measurements of gamma emitters in potatoes and leafy vegetable samples were all less than their respective detection limit (0.02 pCi/g) and are consistent with results in recent years (PNNL-11796). Strontium-90 was detected in two leafy vegetable samples. The Riverview Area sample (0.021 ± 0.008 pCi/g wet wt.) had approximately five times the level of the East Wahluke Area sample (0.004 ± 0.001 pCi/g wet wt.).

4.4.3 Fruit Samples and Analytes of Interest

Grapes were collected during harvest from the areas shown in Figure 4.4.1. All grape samples were analyzed for gamma-emitting radionuclides and strontium-90.

Measurable levels of cesium-137 and other man-made gamma-emitting radionuclides were not detected in grapes in 1998. These results are consistent with measurements in grapes, apples, and melons over recent years (PNL-9824, PNL-10575, PNNL-11140, PNNL-11473, PNNL-11796). The nominal level of detection for cesium-137 was 0.01 pCi/g wet wt. Strontium-90 was detected in the grape sample collected in the Riverview Area (0.005 ± 0.004 pCi/g wet wt.); however, levels in grape samples from the other locations were below detection (<0.004 pCi/g wet wt.).

4.4.4 Wine Samples and Analytes of Interest

Locally produced red and white wines (1998 vintage grapes) were analyzed for gamma-emitting radionuclides and tritium. The wines were made from grapes grown at individual vineyards downwind of the site and at an upwind location in the lower Yakima Valley. Two samples each of red and white wines were obtained from each location and analyzed. The electrolytic enrichment method was used for tritium analysis in water distilled from the wine; however, there were difficulties with the analytical equipment and the samples were lost during analysis. Wine samples were cosampled with the Washington State Department of Health in 1998. Tritium activities based on scintillation detection of water distilled from the wine were provided to the Pacific Northwest National Laboratory by the Washington State Department of Health. The lower limit of detection of the Washington State Department of Health 1998 cosamples was 50 pCi/L.

Gamma spectroscopy did not indicate the presence of cesium-137 or any other man-made gamma emitters in any of the 1998 wine samples. The nominal detection limit for cesium-137 in wine is approximately 3 pCi/L.

Based on results provided by the Washington State Department of Health, tritium activities in 1998 wine samples were slightly higher in the Columbia Basin wines when compared to the Yakima Valley wines (Figure 4.4.4). The Yakima Valley wines were below the detection limit of 50 pCi/L. While there is no tritium standard for wine, the drinking water standard (40 CFR 141) is 20,000 pCi/L. This standard is based on the daily consumption of 2 L of water.

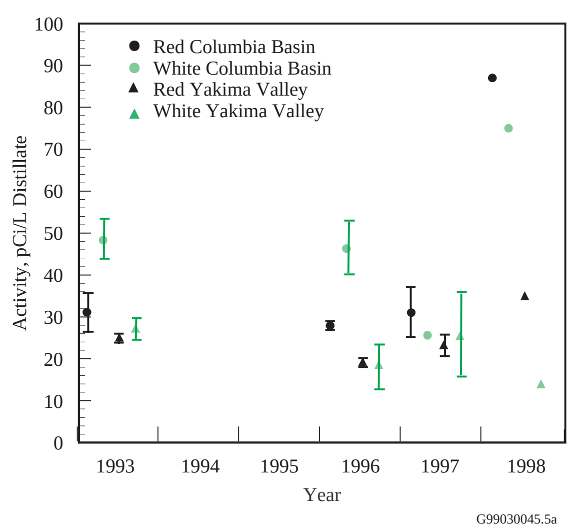

Figure 4.4.4. Median, Maximum, and Minimum Tritium Activities in Wine Samples Collected in 1993 Through 1998 (1998 results from Washington State Department of Health)